# Mortality of Nontarget Insects by Poison Bait Applied to Control the Mediterranean Fruit Fly, *Ceratitis capitata* (Diptera: Tephritidae), in Morocco[1]

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In Morocco where citrus fruit is one of the most important export crops, 607,000 metric tons were exported of the 843,750 metric tons produced in 1971-72. The receipts amounted to $96.4 million (Anonymous, 1972). The Service de Protection des Vegetaux in Morocco, which is charged with the responsibility of controlling pests of citrus so as to increase yields and reduce production costs, is therefore concerned about the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann). The females of this species damage citrus by stinging the fruit, which cause blemishes and a reduction in market quality; the larvae bore into the fruit, which makes it unfit for marketing. At present, the Mediterranean fruit fly (medfly) is controlled in Morocco by applying insecticides or by distributing poison baits (insecticide + protein hydrolysate) (Gilot et al., 1962; Haltebourg, 1966).

The difficulty is that citrus orchards in Morocco range in size from a few solitary trees on 1 to 5 hectares to blocks of 1000 hectares or more. However, in the arid areas where most citrus is grown, the orchards must be surrounded by windbreaks and usually must be irrigated to obtain maximum yields; thus, the number of large orchards is small. Also, the orchards and plants within the windbreaks are the major flora in the ecosystem. As a result, we postulated that when insecticides or poison baits are applied to control the medfly or other pests, the entire ecosystem is affected, and both pest and nonpest species (including parasites, predators, and other beneficial and nonbeneficial insects) may be killed. In fact, some insecticides may select for secondary pest insects, for example, scale insects or mites, which become a problem because *Aphytis* and other parasites and predators are killed.

Therefore, in 1971, a test was made at Chichaoua, Morocco, to determine the effect of medfly bait treatments on nontarget species. The purpose was to obtain an inventory of the variety of insects in a citrus orchard and determine whether there was differential mortality of nontarget insects. The results of the test are reported here.

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[1] Mention of a proprietary product in this paper does not constitute an endorsement of this product by the USDA.

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## Materials and Methods

Two poison bait formulations were prepared (diluted and undiluted). Treatment A consisted of 145 g naled (64.5% EC) and 375 g Ceratue® (protein hydrolysate) mixed into water to make a total volume of 1500 ml. Treatment B consisted of 50 ml of naled (90% ULV technical) mixed with 200 ml of Ceratue to make a total volume of 250 ml. The baits were used for the study because we felt that they would be more attractive and would have more adverse effects on the nontarget insects than insecticide alone (Cunningham et al., 1978). We could also obtain a better census of the variety of insects present in the ecosystem.

The experimental design was a randomized block. Two hundred and fifty ml of Treatment A were applied to each of five replicates (individual trees) in a Valencia orange orchard in October 1971 and 47 ml of Treatment B, same quantity of active ingredients was always applied. Treatment A was applied with a knapsack sprayer, and Treatment B was applied with the Turbair® Tot ULV applicator. A 6 × 6 $m^2$ sheet of plastic was placed under each tree. All insects that were killed during the first 0.4 hr after application fell on the plastic sheet and were counted. No study of residual effectiveness was made.

## Results and Discussion

The data are reported in Table 1. Both treatments killed mostly adult dipterous insects, 88% of total for Treatment A and 82% of total for Treatment B, apparently because these insects were more abundant in the area and contacted or were attracted to the baits. Nearly equal numbers of medflies were killed by the two treatments, but 60% more males than females were killed. In addition, arachnids (spiders) and insects of seven orders were killed and could possibly be adversely affected by successive treatments of baits. The insects killed by the treatments are identified by order in Table 1. There were eight families of Diptera, four families of

TABLE 1.–*Summary of insects killed by poison bait formulations A and B at Chichaoua, Morocco, 1971*

| | Trial treatment* | | | | | |
|---|---|---|---|---|---|---|
| | Trial 1 | | Trial 2 | | Total | |
| Insects killed | A | B | A | B | A | B |
| Medflies | 240 | 197 | 171 | 224 | 411 | 421 |
| Other Diptera | 30 | 251 | 1258 | 757 | 1288 | 1008 |
| Orthoptera | 34 | 36 | 15 | 6 | 49 | 42 |
| Coleoptera | 31 | 112 | | | 31 | 112 |
| Hemiptera | 16 | 29 | 7 | 18 | 23 | 47 |
| Hymenoptera | 34 | 9 | 19 | 25 | 53 | 34 |
| Lepidoptera | 9 | 0 | 3 | 3 | 12 | 3 |
| Arachnids | 29 | 50 | 7 | 21 | 36 | 71 |
| Neuroptera | | | 13 | 29 | 13 | 29 |
| Undetermined | 13 | 14 | 0 | 2 | 13 | 16 |
| Total | 436 | 698 | 1493 | 1085 | 1929 | 1742 |

*Trial 1, Five replicates; Trial 2, four replicates.

Coleoptera, and two families of Hymenoptera. Other orders were represented by one family each: Heteroptera, Neuroptera, Lepidoptera, and Dermaptera.

Division of the insect families identified into target and nontarget groups showed that the family Tephritidae of which the medfly is a representative is the target family, and Anthomyiidae, Chloropidae, Ephydridae, Muscidae, Lauxaniidae, Sepsidae, Syrphidae, Pentatomidae, Aphididae, Chrysopidae, Formicidae, Ichneumonidae, Cantharidae, Curculionidae, Staphylinidae, Tenebrionidae, Yponomeutidae, and Forficulidae are the nontarget families. Division of the species identified into target and nontarget groups showed the target species was *Ceratitis capitata* (Wiedemann), *Paroxyna* sp., *Calliopum hispanicum* (Mik), *Thaumatomyia notata* (Meigen), *Sepsis fulgens* Meigen, *Chrysopa* sp., *Tapinoma nigerrimum* (Nylander), *Lasius niger* (Linnaeus), *Camponotus lateralis* (Olivier), *Cariocondyla* sp., *Apion* sp., *Sitona humeralis* Stephens, and *Tribolium castaneum* (Herbst) are nontarget species. These data show that there was considerable diversity in the nontarget insects in the orchards.

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